

EXTRACTION AND EVALUATION OF PATIENTS' STANDPOINTS PERTAINING TO AYURVEDIC HEALTH TREATMENT

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ABSTRACT

Web-based social networking has detonated as a category of online discussion where individuals create and share the contents at a massive rate. The assessments of web-based social networking clients are currently particularly utilized for decision making. Today's patients have instigated to account their health care experience on the Internet in blogs, social networks, wikis, and on health care rating websites. With the explosive growth of social media (i.e., reviews, forum discussions, blogs and social networks, etc) in the past 10 years, patients are progressively using these media for their decision making regarding the healthcare. Most of us often search out the assessments of others, when we have to settle on a choice need. New analytical strategies, such as sentiment analysis, may enable us to comprehend and utilize this information more adequately to enhance the nature of health care. In this paper authors analyzes the viewpoints and assessment of clients pertaining to ayurvedic health treatment. Comments and reviews of the experienced users of health care organizations are extracted from the websites and their viewpoints are analyzed and classified

Keywords: Sentiment Analysis, Opinion Mining, Machine Learning, Naïve Bayes Classification

I. Introduction

The expansion of telecom and smart phones significantly provide a digital shift to the economy. In the increasingly digitized and connected world, advantages also bring equally important challenges that often require new thinking and approach. One of the primary challenges is "data" that is being generated in huge volumes at enormous pace and in variety of forms. As part of the demonetization and the transition to cashless economy, millions of new users are pushed onto the digital world. Every person is engaged in various kinds of activities on Internet either by using

social media or by online transactions, online shopping or by any other thousands of activities. Due to all these facts they are unintentionally generating massive amount of data every second by their active contribution on Internet. The opinions of social media users are now markedly used for decision making. Our day-to-day life has always been influenced by what people think. Ideas and opinions of others have always affected our own opinions. In this paper, the authors analyses the sentiments of patients regarding ayurvedic health treatment. Tweets and user reviews are analyzed to obtain the sentiment.

a. Ayurvedic Treatment

Ayurveda is totally renowned as a medical science by the World Health Organization (WHO) and has amassed a gigantic wealth of empirical healing knowledge. In India and in some neighboring nations, Ayurvedic drug is formally and legally perceived as keeping pace with conventional medication and they are practicing Ayurveda[4]. Roughly 75% - 80% of the general population in Nepal, Sri Lanka, China, European and Western nations use some form of ayurvedic products and the administrations have built up different therapeutic directions and universities to offer Ayurveda practice to ordinary citizen as well, to empower this medicine system a ceaseless practice [3]. Kerala Ayurvedic Treatment induces deep relaxation and peace of mind. Many ayurvedic hospitals especially located in Kerala offer these conventional ayurvedic treatments and medicines for any type of illness. The examination of the illness is done through the incorporation of physical and mental characteristics.

b. Role of Patients' outlook in Social Media

Typical measures of patient experience include surveys, and more recently, structured patient reported outcome measures. Such approaches ask specific and limited questions, are conducted occasionally, and are often expensive to administer. Today's patients have start in on to account their health care experience on the Internet in blogs, social networks, wikis, and on health care rating websites. Enormous amount of unstructured, free-text information about quality of many ayurveda hospitals and siddha practitioners are available on the Internet in blogs, social networks, and on physician rating websites, but they are not captured in a systematic way and so difficult to analyze the patient's experience. Most of us often search out the assessments of others, when we have to settle on a choice need. With the hazardous development of web-based social networking in the past ten years, patients are progressively utilizing these media for their basic decision making in regards to the medicinal services[2]. To analyze these immense amounts of information available in the form of reviews, blog posts, social media comments and tweets (called as User Generated Content (UGC)) on the web, various text mining tools are applied to the unstructured data to make it as a meaningful data. Even though we are drowning in data, we are in lack of meaningful data. These unstructured data on the web have to be analyzed to find out a meaningful data. New analytical strategies, such as opinion mining or sentiment analysis, may allow us to understand and use this information more effectively to improve the quality of health care.

II. Sentiment Analysis

In recent years, the exponential increase in the Internet usage and exchange of public opinion is the driving force behind Sentiment Analysis today. The Web is a huge repository of structured and unstructured data. Sentiment Analysis or Opinion Mining is the computational treatment of opinions, sentiments and subjectivity of text. Sentiment Analysis (SA) is the computational study of people's judgments, assessments, attitudes and feelings toward entities, individuals, issues, events, topics and their attributes. The whole process of identifying and extracting subjective information from raw data is known as sentiment analysis. It extracts opinions, emotions and sentiments from the data. This process can be used to determine whether a piece of writing in the blog about the treatment is positive, negative or neutral. It derives the opinion or attitude of a patient. Are they happy or satisfied with the treatment or not? Opinions of users not only help individuals in taking informed decisions but also help organizations in identifying patient attitudes, opinions about treatments, services etc. Our intention was to test whether we could automatically predict patients' views on a number of topics from their free-text responses. Machine learning makes sentiment analysis more convenient.

Machine learning approach relies on the well-known machine learning algorithms to solve the sentiment analysis as a regular text classification problem that makes use of syntactic and/or linguistic features [8]. A machine learner uses data containing examples and features of the concept to be learned, and summarizes this data in the form of a model, which is then used for predictive or descriptive purposes. Machine learning algorithms are chosen on the basis of the input data and the learning task. Machine Learning tools can be used to analyze various sentiments which may be mined to know whether the patient suggest that particular treatment for similar type of diseases, whether the services from the hospital is good or bad, about the cleanliness, hospitality etc. This information helps others to know about the treatment before going for it. The machine learning approach had two components: (i) preprocessing which cleans the data, and (ii) classification, in which an algorithm decides which category each comment falls into [5]. The figure 1 shows the various steps in the analysis.

The various steps in Sentiment Analysis are

- i. Collect the corpus
- ii. Pre-process the data and form the training data set.
- iii. Classify and create positive and negative word clouds by applying the sentiment algorithm
- iv. Analyze the result using test data and Check the accuracy of the data.

First collect the available review comments and ratings about the ayurvedic treatments given by various ayurvedic hospitals from various websites and blogs to form the corpus. It is extremely difficult to analyze these big data. It is very time consuming and requires lots of manual effort to read all these reviews and analyze and generate a positive and negative word cloud. Based on English dictionary, we can identify which words are positive and which words are negative. The text input which contains the user reviews can be broken into a set of documents called as corpus. The corpus then should undergo preprocessing to clean the data.

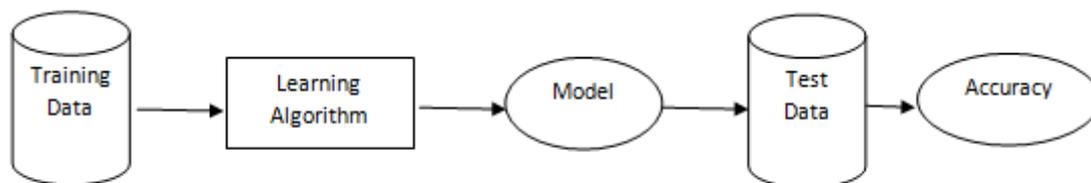


Figure 1: Various steps in Sentiment Analysis

a. Preprocessing

Preprocessing is the process of introducing a new document to the information retrieval system in which each opinion of the patient corresponds to a set of index terms for the efficient storage and retrieval of the data. Preprocessing is from which data from patient comments are split into manageable units to build a representation of the data. Preprocessing or cleaning the data means removing the data which is not required for analysis; ie., cleaning includes stripping whitespaces, removing punctuation marks, stemming, removing stop words, removing website links etc.

b. Classification

In data analysis, algorithms have been developed which can be used to analyze data, with the goal to extract useful information. Some widely used classification algorithms are Naive Bayes and Support Vector Machines (SVM). These algorithms can be used to assign a sentiment (positive or negative) to the patients' tweet or opinion in the blog.

Naive Bayes is a machine learning algorithm which uses the principles of probability for classification. Naive Bayes uses data about aforementioned events to estimate the probability of future events. Classifiers based on Bayesian methods utilize training data to calculate an observed probability of each class based on feature values. When the classifier is used later on unlabeled data, it uses the observed probabilities to predict the most likely class for the new features. The probability of an event can be estimated from observed data by dividing the number of trials in which an event occurred by the total number of trials. For instance, while evaluating the patient's reviews, if 230 reviews contains happy out of 1000 reviews, the probability of happy can be estimated as 23 percent. The notation $P(A)$ is used to denote the probability of event A, as in $P(\text{happy}) = 0.23$.

The total probability of all possible outcomes of a trial must always be 100 percent. Thus, if the trial only has two outcomes that cannot occur simultaneously, such as heads or tails, or negative review or positive review, then knowing the probability of either outcome reveals the probability of the other. For example, given the value $P(\text{negative}) = 0.20$, we are able to calculate $P(\text{positive})$ as $1 - 0.20 = 0.80$. This works because the events are mutually exclusive and exhaustive. This means that the events cannot occur at the same time and are the only two possible outcomes. As shorthand, the notation $P(\neg A)$ can be used to denote the probability of event.

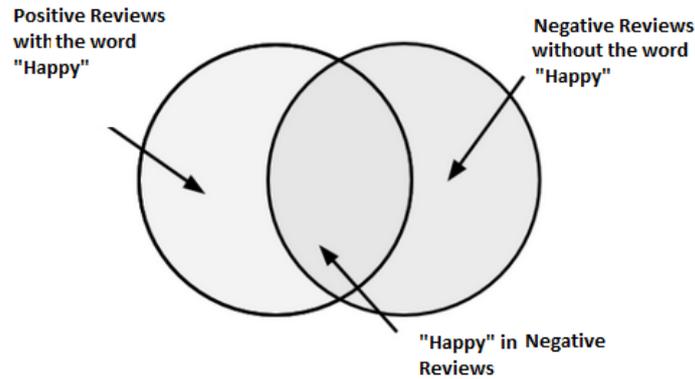


Figure 2: Probability of Happy in Positive and Negative Reviews

If some events occur with the event of interest, we may be able to use them to make predictions. Consider, for instance, a second event based on the outcome that the review message contains the word Happy. For most people, this word is only likely to appear in a positive message; its presence in a message is therefore a very strong piece of evidence that the patient is very much satisfied with the hospital and the treatment. To quantify the degree of overlap between these two proportions, we hope to estimate the probability of both P(positive) and P(Happy) occurring, which can be written as P(positive ∩ Happy). Calculating P(positive ∩ Happy) depends on the joint probability of the two events, or how the probability of one event is related to the probability of the other. The figure 2 shows the probability of the word Happy in positive and negative reviews. If the two events are totally unrelated, they are called independent events. If all events were independent, it would be impossible to predict any event using the data obtained by another. On the other hand, dependent events are the basis of predictive modeling. For instance, the appearance of the word Happy or Clean is predictive of a positive review. For independent events A and B, the probability of both happening is P(A ∩ B) = P(A) * P(B).

According to Bayes' theorem, if there are two events e1 and e2, then the conditional probability of occurrence of event e1 when e2 has already occurred is given by the following mathematical formula:

$$P(e_1 | e_2) = \frac{P(e_2 | e_1)P(e_1)}{e_2}$$

This equation is implemented to calculate the probability of a data to be positive or negative [6]. Conditional probability of a sentiment can be given as:

$$P(\text{Sentiment} | \text{Sentence}) = \frac{P(\text{Sentiment})P(\text{Sentence} | \text{Sentiment})}{P(\text{Sentence})}$$

Conditional probability of a word can be given as:

$$P(\text{Word}|\text{Sentiment}) = \frac{(\text{No. of words occurrence in class 1})}{(\text{No of words belonging to a class} + \text{Total No: of word})}$$

The document can split up into several sentences or words. This process is called as tokenization. It creates small tokens from a big text. In the document we may have so many words. We can count how often each word appears once the text is tokenized which is called as the bag of words. In the “bag-of-words” approach, the total body of words analyzed is represented as a simplified, unordered collection of words [10]. For this analysis, unigrams and bigrams were used as the basic units of analysis. Higher n-grams could have been used, but the constraints were computer power and processing time. The most common single words and the most common 2-word phrases were extracted from the complete set of comments in the corpora. The Table 1 shows the 10 one word or 2-word phrases with the highest predictive accuracy.

Overall Recommendation	Cleanliness	Dignity
thank you	dirty	rude
excellent	floor	thank you
rude	left	friendly
the staff	thank you	excellent
hours	filthy	asked
asked	bed	staff
was told	patients	told
friendly	friendly	left
nice	hours	good
told	rooms	nice

Table 1 the 10 one or two word phrases with the highest predictive accuracy

Then rate the opinion of each as positive, negative, either, or neutral separately for each of the three domains under consideration: (i) overall recommendation, (ii) cleanliness, and (iii) dignity. Cohen’s Kappa statistics for overall ratings were 0.76 for 1 word and 0.71 for 2-word phrases. For rating of dignity, they were 0.71 for 1 word and 0.70 for 2 words. For rating of cleanliness, they were 0.52 for 1 word and 0.48 for 2 words [5]. The data is shown in Table 2.

	1-word phrase	2-word phrase
Overall Recommendation	0.76	0.71
Cleanliness	0.52	0.48
Dignity	0.71	0.70

Table2 shows the ratings of three domains

The whole process can be summarized as shown in Figure 3.

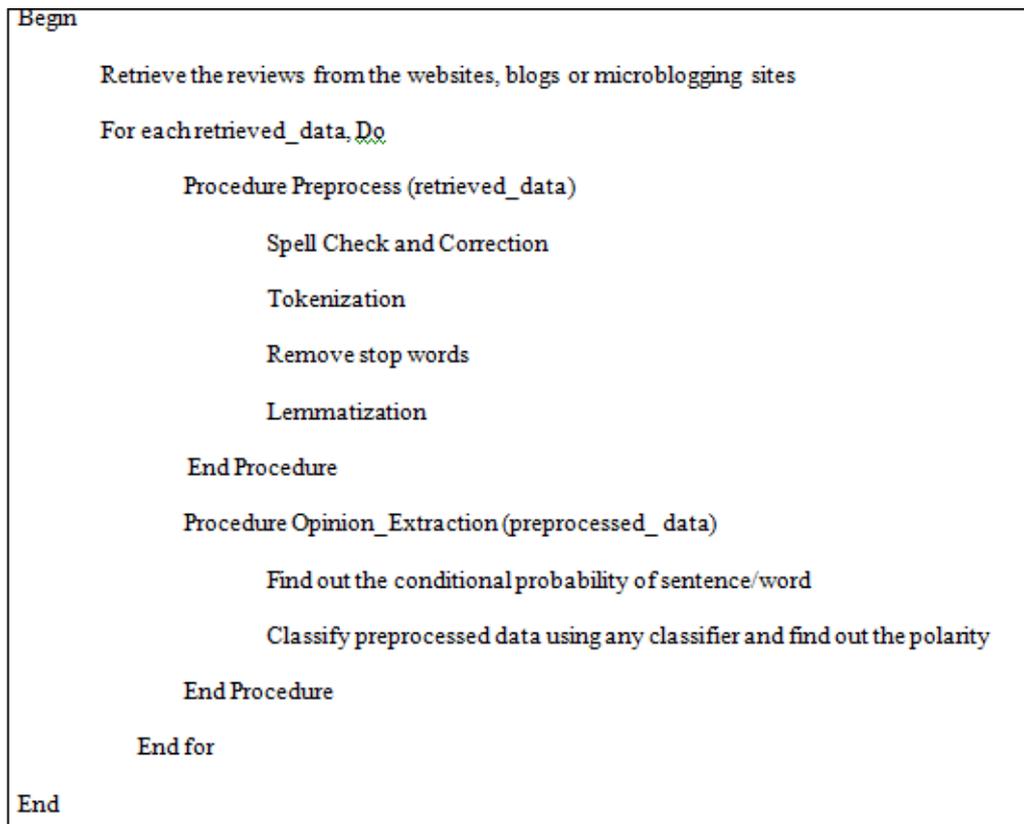


Figure 3: Pseudo code of the process of Sentiment Analysis

A technique called “information gain” can be used to reduce the size of the bag-of-words by identifying those words with the lowest certainty of belonging to a given class, and then removing them. This is an approach to feature selection [9]. This will improve the computation time and also demonstrates the words with highest predictive accuracy.

III. Evaluation

The algorithm was trained using the comments and ratings about hospitals from trip advisor dataset. A sample of review retrieved from the trip advisor website is shown in Table 3 (https://www.tripadvisor.in/Hotel_Review-g1096235-d530306-Reviews-Kairali_Ayurvedic_Health_Resort-Palakkad_Kerala.html). To test the precision of the prediction, we compared our results to quantitative ratings provided by the same individual patients on a Likert scale, which is a psychometric scale commonly involved in research that employs questionnaires. Free-text comments were examined in response to the questions: “What I liked”, “What could have been improved”, and “Any other comments”. A prediction was then made about whether the patient would recommend the hospital or not, whether the hospital was clean or dirty, and whether they were treated with dignity and respect.

<p>“Ayurveda + Satvik Food + Nature at this Ayurvedic Wellness Retreat.” Reviewed 3 days ago NEW</p> <p>...Being a wellness retreat, they are extremely strict about not allowing any kind of addictive substances and narcotics into the property in keeping with the Ayurvedic principles. Coffee is also included among these addictive substances! The food served here is pure vegetarian, fresh, flavourful and Saatvik. Nothing fried or fermented here. Kairali offers various categories of clean and tidy cottages...</p>	<p>“An Ayurvedic Hospital that is also a Resort offering Massages!” Reviewed 4 days ago NEW</p> <p>...Kairali’s factory visit was an amazing experience in itself. I spent time watching a lot of products being made. It’s institutions like Kairali that keep the 5000 year old culture of Ayurveda alive. This Wellness Bloggers Meet Edition II was organized by the Ayurveda Sutra Magazine that provides a new dimension to health & wellness.</p>
<p>“Rejuvenate, refresh and revitalize with Ayurveda and nature” Reviewed 6 days ago NEW</p> <p>The resort focuses on wellness and well being of guests by offering lush greenery, beautiful lawns, water bodies, saatvik food, yoga, meditation, sports and more. The food is totally vegetarian, light on stomach at the same time delicious. Each guest is fed with food and treated with respect to their health requirement as per prescribed by the doctors in resort....</p>	<p>“Decelerate” Reviewed 23 November 2016</p> <p>...In enjoyed the really tasty and good food during my stay and that even with strict diet I wasn’t hungry. The kindness and hospitality of the whole waiters inside the restaurant was outstanding. Every 2 weeks they do a special food served on a banana leave, you get many different curries and marsalas. a explosion of taste buds.</p>

Table 2 : Sample reviews from tripadvisor website about Kairali Ayurvedic Health Resort in Kerala

The accuracy of the prediction was compared with the patient’s own quantitative rating by calculating, for each method, the accuracy (the percentage of correctly predicted observations from the total number of observations), the F measure (the harmonic mean of precision and recall), the Receiver Operating Characteristic (ROC), and the time taken to complete the task were calculated. In order to see the true positive and false positive rates, ROC Curve is very helpful. The figure 4 shows the predicted probabilities for the positive class. The line right on the diagonal serves like a boundary between the good and bad models. The curve approaching to the top left hints a good fitting model.

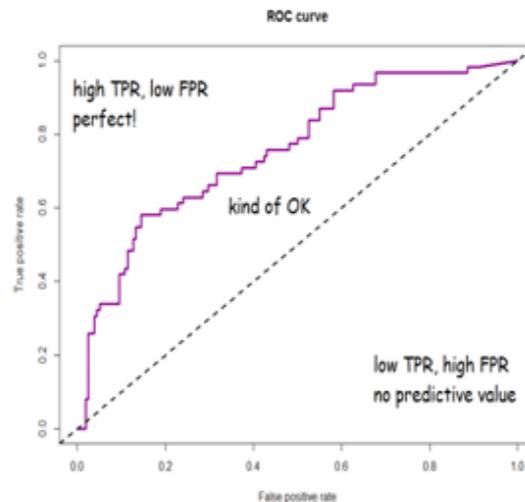


Figure 4: ROC curve showing the probabilities for the positive class.

IV. Conclusion

This work demonstrates that sentiment analysis of patients' comments and reviews about their experience of health care is possible and that this approach is associated with patient experience measured by traditional methods such as surveys. The comments, reviews and ratings about hospitals left on some top and best websites and blogs for ayurvedic related topics is analyzed and classified the user review comments. The work can be extended to consider more attributes or domain for classification. The feature selection approach like information gain, gini index etc can be used to improve the computation time and also demonstrates the words with highest predictive accuracy. A number of different technical approaches can be taken to classification in machine learning, to see which gave the quickest and most accurate results.

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